

MOTION ANALYSIS
EDITORIALInstrumental motion analysis: from the research
laboratory to the rehabilitation clinicMaria Grazia BENEDETTI ^{1*}, Stefano NEGRINI ^{2, 3}¹Physical Medicine and Rehabilitation Unit, Istituto Ortopedico Rizzoli, Bologna, Italy; ²Department of Clinical and Experimental Sciences University of Brescia, Brescia, Italy; ³IRCCS Fondazione Don Gnocchi, Milan, Italy*Corresponding author: Maria Grazia Benedetti, Via Pupilli 1, 40136 Bologna, Italy. E-mail: mariagrazia.benedetti@ior.it

The purpose of this Special Section is to describe the state of the art in the clinical application of methods and instruments for the quantitative assessment of gait and motion of other body segments in people with motor disability.

Advanced technologies for motion analysis (MA) conventionally consist of stereophotogrammetric devices to measure body segments and joint kinematics, force plates for measuring forces at joints, electromyographic systems to evaluate muscular activity during motion. Appropriate protocols are used for human body capture, modelling and rendering of biomechanical information in clinically meaningful terms.¹⁻³

Research in the field of human motion is very active, and many scientific papers are available both on methodological issues and on clinical research. While originally MA was widely used for assessing gait abnormalities (gait analysis, GA), clinical interest in the motion of other human body segments such as the upper extremities and the trunk has grown in the last few years and a number of scientific articles have been published.

Unfortunately, results of research have not always been systematically transferred to the clinic. Up to now, the use of MA techniques as a diagnostic tool able to influence the clinical decision-making process in a clinical context has been demonstrated only in a few pathologies, particularly gait abnormalities using GA in cerebral palsy children.⁴⁻⁶

The applied use of these advanced health technolo-

gies in clinical practice thus continues to be challenging. A list of research priorities in the field have been identified by the Research Committee of the Gait and Clinical Movement Analysis Society (GCMAS)^{7, 8} in terms of efficacy of GA as a clinical decision-making tool and as a functional outcome measure, as well as in terms of education and data sharing.

In a previous EU project, CAMARC I-II (Computer Aided Movement Analysis in a Rehabilitation context)^{9, 10} the potential of a standardised MA approach for clinical use had already been introduced. In recent years several reviews have been carried out to address research priorities in GA, investigating both data reliability¹¹ and proof of the effectiveness of GA as a clinical tool in specific groups of patients.¹²⁻²⁶

Efforts are currently underway in countries with more experience in the gait analysis field, to guarantee quality standards in clinical services. A Consensus Conference on gait analysis in Rehabilitation was held in Italy, under the aegis of the Italian Society of Movement Analysis (SIAMOC, www.siamoc.it), the UK and Ireland movement analysis society (CMAS, <http://cmasuki.org>): Clinical Gait Analysis Standards were agreed. The US now have a Commission for Motion Laboratory Accreditation (<http://www.cmlainc.org>). Recently a master's degree programme in clinical movement analysis (www.CMAster.eu) was implemented.

To summarize the role MA plays in a clinical context, three main areas have been explored in terms of its ef-

fectiveness: support in decision making, improvement of outcome for patients, and reduction of health costs.²

The Commission for Motion Laboratory Accreditation defines Motion Analysis as “a standard diagnostic laboratory procedure present in many clinical facilities which treat patients with gait dysfunction or other disorders of human movement. The ultimate goal of these clinical laboratories is to evaluate individuals for quantifying their movement disorder and determining the specific anatomic, physiologic or functional cause of their movement pattern”.

A recent review on GA²⁷ concluded that there is strong evidence for the technical, diagnostic accuracy, diagnostic thinking and treatment efficacy of gait analysis, also indicating some efficacy at the higher levels of patient outcomes and societal cost-effectiveness. However, it is not clear how advanced technologies for human motion analysis are used in the clinical routine of European countries, and how they impact on health care systems. Furthermore, if GA is a well-established tool included in clinical practice with a good cost/effectiveness ratio, no evidence has been provided, up to now, that MA of other body segments, such as shoulder motion analysis²⁸⁻³⁰ or trunk motion assessment,³¹⁻³³ has an impact on clinical decision making.

Since it is the mission of the European Journal of Physical and Rehabilitation Medicine (EJPRM) to publish papers of clinical interest in Physical and Rehabilitation Medicine, this special section was thought to provide support to readers for the use of motion analysis services according to the best evidence. Three papers are included. The first deals with the clinical facts of GA: methodological and educational issues related to the activity of a clinical gait service are presented together with the biomechanical features most commonly explored in the clinical management of CP children, hemiparesis, and amputation. The second paper is dedicated to the main aspects of shoulder MA, and their potential for everyday clinical practice. Shoulder motion is very complex and methodological issues had to be overcome in order to provide clinically reliable and meaningful measures and so enjoy the advantage of including quantitative motion analysis in the assessment of a patient's shoulder. Recommendations for movement assessment, an overview of the main quantitative motion analysis protocols and a description of the most commonly investigated scapulothoracic muscles are here reported.

The third paper is a systematic review, whose aim is to present the current state of the art in spine MA. Similarly to the shoulder, the trunk poses modelling problems and there are, at this time, neither a shared assessment methodology, nor evidence of the usefulness of clinical application of trunk motion analysis in everyday practice. A synthesis effort is thus required in the field in order to plan future research priorities for clinical use.

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Conflicts of interest.—The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript. Article first published online: July 26, 2016. - Manuscript accepted: July 25, 2016. - Manuscript received: July 18, 2016.

(Cite this article as: Benedetti MG, Negrini S. Instrumental motion analysis: from the research laboratory to the rehabilitation clinic. *Eur J Phys Rehabil Med* 2016;52:557-9)